Amendments to the Specification:

Please amend paragraph [0003] as follows:

[0003] Test structures are fabricated in order to enhance defect detection and/or analysis of a microfabrication manufacturing process. Test structures may be included in a variety of objects, such as but not limited to integrated circuits, masks (for fabricating integrated circuits, flat panel displays and the like), MEMS devices and the like. They may be located at various locations on these objects, such as in the integrated circuit die or in scribe lines on semiconductor wafers. In many cases the size of a defect is much smaller than the size of the test structure and there is a need to locate the defect within the test structure in order to perform classification and root cause analysis. The localization of the defect is difficult and time consuming, especially in the context of integrated circuit manufacturing, and failure analysis devices, such as Defect Review Scanning Electron Microscope (DR-SEM) that are utilized during said manufacturing process.

Please amend paragraph [0008] as follows:

[0008] OBIRCH--Optical Beam-Induced Resistance CHange--Nikawa-san of NEC publications at ISTFA and IRPS 1999 and 2000: an optical beam is raster scanned over the structure and the supply current or voltage is monitored. The optical beam (usually IR) heats the structure locally, ~~and~~ temporarily increasing the resistance of the element heated. When a defective high resistance structure is heated, the resistance change is often greater and results in a larger and readily detectable change of supply current (or voltage or in the case of a constant current supply). An OBRICH image can be produced by plotting the change in supply current or voltage against the position of the optical beam in the raster--defects show as bright (or dark) areas in the image corresponding with the larger change in current or voltage induced by the presence of the defect.

Please amend paragraph [0011] as follows:

[0011] The invention provides a defect localization method that includes: (i) receiving a test structure that comprises at least one conductor and an electro-optically active material that is positioned such as to provide an indication about the electrical status of at least one or more of the conductors of the test structure; (ii) providing an electrical signal to the conductor and (iii)

imaging the test structure to locate a defect.

Please amend paragraph [0012] as follows:

[0012] The invention provides a system for defect localization that includes: (i) means for providing an electrical signal to at least one conductor of a test structure,~~; whereas~~ wherein the test structure comprises at least one conductor and an electro-optically active material that is positioned such as to provide an indication about the electrical status of one or more of the conductors of the test structure; ~~and~~ (ii) means for illuminating the test structure; (iii) at least one detector, for detecting light scattered or reflected from the test structure; and (iv) a processor for processing detection signals from the detectors to locate a defect.

Please amend paragraph [0018] as follows:

[0018] Figures 3a, 3b, 7 and 8 are flow charts of ~~method~~ several methods for defect localization, according to various embodiments of the invention;

Please amend paragraph [0023] as follows:

[0023] Figure 6a is an image of a defective test structure, the image acquired during optical voltage contrast mode, according to an embodiment of the invention[[.]];

Please amend paragraph [0024] as follows:

[0024] Figure 6b ~~is various~~ depicts images of a non-defective test structure as well as of two defective test structures, according to an embodiment of the invention; and

Please amend paragraph [0028] as follows:

[0028] Figure 1 depicts prior art test structures. FIG 1A depicts a comb structure 10 that includes ~~a~~ an interdigitated fingers structure connected to ~~large probes~~ probe pads 20 that are connected to an ohmmeter. Structure ~~20~~ 10 is commonly used for detecting electrical short-type defects such as metal stringers. An electrical short, such as short 22, between any two fingers is readily detected by electrically measuring the resistance between the two interdigitated comb structures. Such shorts can also be detected using beam induced voltage contrast when one side of the comb is electrically floating and the other side is electrically grounded. However, it is not possible with this structure to localize the defect with voltage contrast. When a short defect in a

comb is undetectable using inspection methods, it is extremely difficult and time consuming to localize the precise location of the defect for root cause analysis or classification.

Please amend paragraph [0029] as follows:

[0029] Figure 1B depicts a prior art test structure 11 that has a serpent structure that typically includes a chain of vias between two metal layers. Each of the two ends of the serpent structure is connected to ~~large~~ probe pads 20 that in turn are connected to an ohmmeter. An electrical open defect, such as open defect 24, can readily be detected by an electrical test of the structure. Localization of these defects can be accomplished using the methods depicted in FIGS. 2a and 2b. However, if the open defect is not characterized by a very high resistance or is completely open, localization is very difficult even with beam-induced voltage contrast as the beam induced current through a high resistance defect often does not result in a sufficient voltage difference across the defect for that voltage difference to be detected by voltage contrast.

Please amend paragraph [0030] as follows:

[0030] Figure 1c depicts prior art test structure 12 that includes a one-sided comb with floating comb fingers 26 designed to enhance localization with beam-induced voltage contrast (BIVC). KLA-Tencor's Microloop product uses a similar one sided comb-like test structure where one side of the comb is comprised of electrically isolated fingers. This approach facilitates localization of a short defect, such as defect 28, to a particular pair of fingers in the comb but further inspection is required to localize the defect itself. Open defects can be detected but only in the grounded comb fingers. This structure is also limited because the resistance of the short defect is typically unknown with the BIVC method (and no pads exist for electrical test) and hence it is very difficult to know if a defect is a nuisance defect as for example would be the case for a 10 M ohm metal stringer in a logic circuit. Conversely a high resistance open defect (10-10 M+ ohms) in ~~of~~ the grounded comb fingers will not be detected with voltage contrast. If the short defect cannot be detected by inspection, localization remains difficult and slow.

Please amend paragraph [0031] as follows:

[0031] Figure 2a is an example test structure electrical defect detection localization method flow diagram. Method 200 includes step 210 of providing a structure that can be inspected by a probe based inspection method, step 220 of inspecting the structure, typically

using an optical based inspection method, to detect visible defects, step 230 of performing visible defect ~~defects~~ review and classification, steps 240 and 250 of performing a probe based test, while using visible defect information gained from previous steps as well as from conventional electrical tests, and step 260 of cross sectioning the structure to further evaluate the status of the structure. The principle limitation of method 200 is that ~~is~~ it cannot be used to locate defects that cannot be detected by inspection--which is increasingly a problem for optical inspection tools and for subsurface electrical defects such as high resistance contacts and vias.

Please amend paragraph [0033] as follows:

[0033] Figure 3A is a flow diagram of a method 300 of an embodiment of the invention for localizing a defect in a test structure (and other structures) in an optical voltage contrast mode. Method 300 includes: "start" step 310, step 320 of providing a test structure that includes an upper electro-optically active layer, step 330 of applying a voltage or current to the test structure (collectively applying an electrical signal that can include using a voltage source, current source or combination thereof or applying charge or ~~apply~~ an electrical signal to charge at least a conductor portion of the test structure), step 340 of imaging the test structure in optical voltage contrast mode to determine the location of a defect in the test structure. The method can be repeated for multiple test structures (as indicated by step 350 "go to next structure or stop loop").

Please amend paragraph [0034] as follows:

[0034] The electro-optically active layer can be made of materials such as a liquid crystal or a birefringent material (preferably electro-optically active polymers). Optionally, the electro-optically active layer is coated with a non-opaque (transparent, semi-transparent or translucent) conductive layer. Step 340 of imaging may include illumination with polarized light optionally from a laser light source as depicted in FIGS. ~~6~~ 5A-5B.

Please amend paragraph [0035] as follows:

[0035] Figure 3B is a flow diagram of a method 302 for localizing a defect in a test structure. Method 302 includes steps 310 ("start"), 320-350 of method 300 and an additional step 315 that precedes step 320. Step 315 includes analyzing a test structure that does not include the

electro-optically active layer, by a prior art inspection method, such as those mentioned above, including an optical inspection and electrical testing to locate defects. These defects may be later imaged during step 340, although step 340 includes inspection of other areas of the test structure, to locate defects that were not located during step 315.

Please amend paragraph [0036] as follows:

[0036] Figure 4a depicts a test structure 400 that includes a substrate 424 (typically made of silicon), a dielectric insulator layer 420 located above the substrate, multiple conductors 426 that form the conductive part of the test structure (typically made of copper or aluminum) that are partially surrounded by the dielectric insulator layer 420. The upper surface of the dielectric insulator layer 420 as well as the conductors 426 are coated with electro-optic layer 410, that in turn is located beneath an optional transparent or semitransparent conductive layer 414. The functionality of the conductive layer 414 is further described at Figure 4c. It is mainly used for increasing the E-field within electro-optic layer 410 being induced by the provision of voltage to conductors 426 of the test structure 400. ~~n.~~ It is noted that when using copper ~~made~~ conductors, there is a need to add a temporary layer of passivation to the test structures to prevent rapid corrosion of the copper. The electro-optic layer 410 in many circumstances can also suffice as a temporary passivation layer to prevent or delay this undesirable corrosion.

Please amend paragraph [0037] as follows:

[0037] Figure 4b depicts in more detail the arrangement of a high resolution optical microscope for imaging and detecting defects, as well as ~~and~~ a test ~~structures~~ structure that includes an electro-optic layer such as layer 410. A high resolution optical microscope 510 is positioned such as to direct light towards a test structure 400 and to receive light reflected or scattered from said test structure. In addition, probe based measurements are facilitated by providing a probe card 516 that may be connected to probes such as probe 512 that may contact a conductive pad that is positioned below a window within the electro-optical layer 410 (as well as the conductive layer 414). Figure 4b describes a probe 512 that can contact the conductors of the test structure 400. Optical microscope 510 and probe card 516 may be connected to a processor (which may be included within the microscope) that is capable of receiving optical detection signals from microscope 510 and electrical signals from card 516 and processing said signals to locate a defect. The system usually generates an image, but this is not necessarily so.

Please amend paragraph [0038] as follows:

[0038] Figure 4c illustrates the electric field within the electro-optic layer with and without an the optional transparent or semitransparent conductive layer 414 of test structure 400. This layer prevents the leakage of an electrical field flux from one conductor 426 to ~~the other~~ another and increases the amount of flux that is directed outside the test structure. The Figure also describes the potential of each of the three conductors. While the provision of a conductive layer adds processing complexity, it provides a stronger E field over the surface of the structure.

Please amend paragraph [0039] as follows:

[0039] Figure 5a depicts an optical system 500 as well as an inspected test structure, such as test structure 400 of Figure 4a that includes an upper electro optical layer 410 and optionally a conductive layer 414. An optical microscope is used for imaging the test structure, and Figure 5a illustrates some of the components of said microscope.

Please amend paragraph [0040] as follows:

[0040] Optical system 500 includes means for ~~means for~~ providing an electrical signal such as electrical stimulus unit 562 and even phase unit 560; means for illuminating the test structure, such as laser 550, polarizer or quarter wave plate 552, beam splitter ~~562~~ 563 and objective lens 430; at least one detector, such as camera 556 and a processor (not shown) for processing signals from the at least one ~~de3tector~~ detector, and can also coordinate the operation of various parts of optical system 500. The processor may analyze the signals to provide the location of a defect (by tracking the changes in color of the image, in response to the shape of the conductors of the test structure), but this is not necessarily so and once an image is provided to a user, the user can determine the location of the defect.

Please amend paragraph [0041] as follows:

[0041] An XY stage 564 provides for moving the test structure 400 relative to the microscope to allow imaging of the complete test structure 400 and for moving between test structures. The system may also have z-axis movement capabilities for functions including focusing manipulating the probecard. Electrical stimulus is provided to the test structure (via pads that are connected to the conductors 426 of the test structure 400) by electrical stimulus unit

562. The electrical stimulus can be DC or AC and the phase of the AC can optionally be adjusted or synchronized, by phase unit 560, with the camera ~~image~~ 556 ~~capture~~.

Please amend paragraph [0042] as follows:

[0042] A light source, preferably polarized and preferably a laser 550 passes through a polarizer 552 and a beam splitter ~~562~~ 563 before entering an objective lens 430. Light returned from the test structure 400 is reflected by the beam splitter ~~562~~ 563 through a polarizer/analyzer 554 and into a CCD camera 556 for image capture. The intensity in the image is a function of orientation of the polarizer/analyzer 554 and any change in polarization to the incident light induced by the electro-optic material layer on the test structure surface. An E field in the active ~~electron optical~~ electro-optic layer 410 induced by a voltage provided to the test structure by electrical stimulus unit 562, will proportionately alter the polarization state of reflected light from the test structure 400. The polarizer/analyzer 554 can be rotated to maximize the change in intensity or sensitivity seen in acquired image. A defect will appear as either a light or dark region in the acquired and displayed image, as illustrated in FIGURE. 6. The acquired image can be stored, displayed (the display image is denoted OVC--Optical Voltage Contrast image 558), manipulated to enhance contrast or to automatically locate the defect.

Please amend paragraph [0043] as follows:

[0043] Figure 5B illustrates system 502 and test structure 400. System 502 images test structures 400 in OVC mode. System 502 has a scanner 570 positioned downstream of the light source 550, and includes a detector 568 and sensitive signal-processing electronics 566. The optical setup is similar to that of system 500 but further includes the optical scanner 570, a second beam splitter ~~562~~ 563, an additional polarizer/analyzer 554, a detector 568 and signal processing electronics ~~556~~ 566 for enhancing the sensitivity of the system.

Please amend paragraph [0044] as follows:

[0044] Optical scanning of a finely focused light spot is accomplished with an optical scanner 570 that includes piezo activated mirrors or prisms or similar scanning capability. System 502 can implement confocal laser scanning microscopy to enhance resolution and contrast in the resulting OVC image. An optional separate optical path is provided with a CCD camera 556 for purposes of setup, focus and alignment. The focused spot of light passes through

the microscope objective 430 to the test structure 400. Its polarization state is changed in proportion to the E field in the EO layer 410 on the test structure 400. The reflected light is further reflected by a beam splitter ~~562~~ 563 through a polarizer/analyzer 554 and into a sensitive light detector circuit 568 that is illustrated as a light sensitive diode connected to a resistor. The detector circuit 568 may include a photo diode (PN, PIN, Avalanche etc.) or a Photo Multiplier Tube. Sensitive signal processing electronics 566 is used to extract the resulting signal from the noise. Preferred signal processing techniques include phase sensitive rectification or amplification in appropriate phase with either a chopped optical beam (chopper not shown) or in appropriate phase to an AC stimulus to the test structure. An OVC image 558 of the coated test structure is constructed by raster scanning the light spot over the structure.

Please amend paragraph [0047] as follows:

[0047] Note that the defect is typically located at (or near) the discontinuity in the gray level of the conductors that form the test structure. Note also that the discontinuity is present, even when the defect is a high resistance defect. In serpents and via chains, the magnitude of the discontinuity is typically proportional the resistance of the defect._Figure 7 is a flow diagram of method 700 for defect localization. Method 700 includes: "start" step 710, step 720 of receiving a test structure that includes an electro-optically active layer, step 730 of applying ~~DA~~ DC or AC voltage or current to the test structure that is known to be defective, step 740 of imaging the test structure in optical voltage contrast mode, and step 750 of analyzing the image (tracking grayscale difference) to determine the location of a defect in the test structure. The method can be repeated for multiple test structures (as indicated by step ~~750~~ 760 "go to next structure or stop loop").

Please amend paragraph [0049] as follows:

[0049] Figure 8 is a flow diagram of method 800 for defect localization. ~~Method 800 includes:~~ Method 800 includes: "start" step 810, step 820 of receiving a test structure that includes an electro-optically active layer, step 830 of applying an AC voltage or current to the test structure that is known to be defective, step 840 of acquiring a first image of the test structure in optical voltage contrast mode, during a first phase of the AC voltage or current, step 850 of acquiring a second image of the test structure in optical voltage contrast mode, during a second phase of the AC voltage or current and step 860 of analyzing the first and second images

to determine the location of a defect in the test structure. Step ~~560~~ 860 may include comparing the pictures, generating a difference image and the like. Various methods for manipulating the pixels of each picture may be used. The method can be repeated for multiple test structures (as indicated by step ~~850~~ 870 "go to next structure or stop loop"). It is further noted that more than two images of the same test structure can be acquired. Usually, the acquisition of multiple images improves the signal to noise ratio.

Please amend paragraph [0051] as follows:

[0051] Figure 9 illustrates a test structure 400 that is inspected by a two step localization method that include a first coarse scan of the test structure that is followed by a finer scan[[,]]. The test structure can be larger than the ~~filed~~ field of view of the imaging optics, thus multiple step and scan steps are required.

Please amend paragraph [0052] as follows:

[0052] According to various embodiments of the invention: (i) the test structure can be backside illuminated with infrared illumination having a wavelength of about 1.06 microns;[[.]] (ii) test structures include an electro-optically active substrate such as GaAs or the substrate can act as the electro-optically active layer; (iii) the electro-optically active material is birefringent, a polymer, DAN [4-(N,N-dimethylamino)-3-acetamidomitrobenzene], COANP [2-cyclo-octylamino-5-nitropyridine], PAN [4-N-pyrrolydino-3-acetaminomitrobenzene, MBANP [2-(alpha-methylbenzylanino)-5-nitropyridine], or liquid crystal; (iv) the electro-optically active material is disposed by spin-on, PVD, CVD or ALD; (v) the electro-optically active material is disposed such as to have a thickness that is substantially equal to a width of at least one conductor; (vi) the test structure is imaged with a resolution to detect defects comparable in size to a smallest dimension of a conductor of the test structure; and (vii) the resolution is selected in response ~~of~~ to a dimension of at least one conductor~~; (viii)~~.